Finding transiting exoplanets in young open clusters with Kepler K2

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Transiting planets are ``Rosetta Stones'' because they provide clues on the contents of exoplanetary atmospheres, offering a great potential to molecules that may reveal the presence of life beyond our own planet Earth. The transit of a planet, combined with radial velocity measurements, provides the mass and the radius of the planet, the planetary brightness temperature, the planetary day-night difference, and absorption features of the planetary upper-atmosphere constituents like sodium, hydrogen, water, and methane.

In our current knowledge of the Earth, little is known about its evolution during the first hundreds of million years. It is important to understand the evolution of exoplanets with time to provide key information in the

early history and composition of our planet. This work aims at addressing important aspects such as (1) the frequency of planets in clusters, (2) the evolution of planet interiors as a function of age, and (3) planet formation models and the effect of migration. To address these questions, we plan to take advantage of the Kepler K2 mission that will monitor several nearby clusters/regions with a wide range of age for 70--80 days continuously during campaigns 4 and 5: rho Oph (~1 Myr), Upper Scorpius (5-10 Myr), the Pleiades (125 Myr), Praesepe (590 Myr), and the Hyades (625 Myr). The main advantage of cluster members is that they are born in the same cloud at the time under the same environment. Hence, they represent ideal targets to look at the formation and structure of planetary systems and the evolution with time of the composition and atmosphere of exoplanets. We will be sensitive to short period super-Earths and larger planets around well-characterised young solar-type star and M dwarf members. If the current empirical frequency of planets hold at young ages, we expect to discovery at least one super-Earth per cluster. The frequency of planets at young ages is currently unknown and only 2.8% of the hundreds of the planet-host stars known to date are younger than 600 Myr.

Our team will focus on the Pleiades, Praesepe, and Hyades where we identified bona-fide cluster members photometrically and astrometrically in an homogeneous manner using the near-infrared survey conducted by the UKIDSS Galactic Clusters Survey. We have already obtained optical spectra for a large number of member candidates with a battery of telescopes and instruments. We have also obtained high-resolution lucky-imaging data for more than 500 high-mass and low-mass members of the Pleiades and Praesepe, which will be combined with other works conducted in the Hyades. Hence, we know the level of activity, spectral type, temperature, and multiplicity properties of our target stars.

We compiled the most up-to-date list of high-mass and low-mass members in the Pleiades, Praesepe, and Hyades clusters with a wide range of spectral types and magnitudes using the catalogues of Stauffer et al. (2007, ApJS, 172, 663), Kraus & Hillenbrand (2007, AJ, 134, 2340), and Goldman et al. (2013, A&A, 559, 43) complemented by our latest studies.